

[Nuclear energy] requires a social commitment, and perhaps even a stability of the society, over very long times to maintain the expertise, the quality assurance, the vigilance that will keep us out of trouble.

Alvin M. Weinberg
Science, 7 July 1972

INFECTIOUS DISEASE

In Disaster's Wake: Tsunami Lung

When the Asian tsunami struck on 26 December 2004, health authorities braced for an onslaught of waterborne illnesses including malaria and cholera, which often follow such disasters. But saltwater flooded the freshwater breeding grounds of the mosquitoes that spread malaria, and relief agencies quickly distributed bottled water, thwarting a cholera epidemic. Instead, a type of aspiration pneumonia named "tsunami lung" emerged and afflicted some survivors.



New concerns in devastation's wake. Some survivors of the tsunami that struck South Asia on 26 December 2004 are experiencing a new peril—mud and bacteria they inhaled as they were swept along with the waves has led to a type of aspiration pneumonia called "tsunami lung."

Tsunami lung occurs when people being swept by tsunami waves inhale saltwater contaminated with mud and bacteria. The resulting pneumonia-like infections normally are treated with antibiotics. However, the 2004 tsunami "wiped out the medical infrastructure, and antibiotics were not available to treat infections in the early stages," says David Systrom, a pulmonologist at Massachusetts General Hospital in Boston. Consequently, victims' lung infections festered, entered the bloodstream, and spread to the brain, producing

abscesses and neurological problems such as paralysis.

Systrom and colleagues volunteered to work on a medical disaster team with Project HOPE (Health Opportunities for People Everywhere) aboard the hospital ship U.S. Naval Ship *Mercy* off the coast of Banda Aceh, Sumatra. When they arrived three weeks after the tsunami hit, "we saw infections not seen in the United States since before the development of antibiotics," says Systrom. Among them were about 25 cases of tsunami lung. "No one expected the number of tsunami lung cases we saw," says Systrom. "It was not on the radar screen."

The diagnosis of tsunami lung requires a chest radiograph and computed tomogra-

phy scan of the brain to confirm abscesses. This sophisticated equipment was available on the hospital ship. "Only the most severe cases with central nervous system involvement made it to the ship," says Systrom. The team suspects that hundreds of milder cases went unreported.

In the 23 June 2005 issue of the *New England Journal of Medicine*, the team describes the case of a 17-year-old girl who aspirated water and mud while engulfed by a wave and carried about half a mile. She developed pneumonia two weeks later and

was treated at a local clinic with unknown medicines. A week later, the right side of her face drooped, her right arm and leg became paralyzed, and she stopped talking.

A chest radiograph revealed air and pus outside the lining of the lung (a condition known as hydropneumothorax), and a brain scan showed four abscesses. After the doctors treated her with a combination of intravenous antibiotics (imipenem until the stock of that drug ran out, then vancomycin, cef-tazadime, and metronidazole), her speech and facial movement recovered first. When she moved her right leg and arm for the first time, she "burst into peals of laughter," according to the report. She was transferred to an International Committee of the Red Cross-Crescent field hospital. "I suspect she'll fully recover," says Sydney Cash, a neurologist at Massachusetts General Hospital and member of the team, who has since received pictures of her walking.

A combination of microbes likely contributes to tsunami lung, but no lab facility was available to culture and identify those found in the Indonesian patients before the *Mercy* arrived. However, in a letter published in the 4 April 2005 issue of *The Medical Journal of Australia*, Anthony Allworth, director of infectious diseases at Royal Brisbane and Women's Hospital, describes culturing *Burkholderia pseudomallei* from two tsunami lung patients in a land-based hospital and *Nocardia* species from a third.

B. pseudomallei lives in the Asian soil and water. Mark Pasternack, an infectious disease specialist at Massachusetts General Hospital who also served on the *Mercy*, says, "You do not have to directly aspirate *Burkholderia* to produce pneumonia. . . . After the tsunami, people had soft tissue injuries from being forced into objects, so they could have gotten *Burkholderia* from wounds or aspiration."

Cash echoes this thought: "Natural disasters produce odd combinations of pathogens and unexpected ways for the body to be damaged that lead to unexpected clinical circumstances. [Medical disaster physicians need to] keep an open mind and expect the unexpected."

Could an infection like tsunami lung emerge in victims of Hurricane Katrina? Probably not, speculates Pasternack. Although the water sweeping the Gulf Coast area may have been contaminated, "it was not forced down peoples' lungs by high-speed waves," he says. Therefore, aspiration pneumonia and its complications are unlikely to appear commonly during the Gulf Coast relief efforts. —Carol Potera

RADIATION

Any Dose Is Too High

Any exposure to radiation may cause cell damage that could lead to cancer, according to a June 2005 report from the National Research Council. The risk noted by the report, though small, is a third higher than the risk of 8.46 cancers per 10,000 people exposed to 1 rem (or 10 millisieverts [mSv]) currently used by U.S. regulators. The report contradicts critics who believe there is a threshold below which radiation is harmless; it also fails to support those who say low doses of radiation cause greater health damage per unit dose than high levels.

The seventh Biological Effects of Ionizing Radiation (BEIR) report, sponsored by several federal agencies, assessed and updated the health risks from low linear energy transfer (low-LET) radiation, which deposits little energy in a cell and thus tends to cause little damage. The last BEIR report that addressed these health risks was published in 1990.

Richard Monson, a professor of epidemiology at the Harvard School of Public Health and chair of the group that conducted the study, says, "We judged that the most reasonable shape is a line through the origin." Simply put, this means any low-LET ionizing radiation may increase the risk of a cell becoming cancerous—there is no threshold below which there is no risk—and as exposure increases, so does the health risk. Researchers refer to this straight line as the linear-no-threshold model.

Less than 20% of people's low-level radiation exposure comes from anthropogenic sources. The Earth and cosmic sources emit the remainder. Nearly 80% of human-induced exposure comes from medical procedures, about 15% from products like tobacco and building materials, and around 5% from exposure at work.

For the purpose of the BEIR VII report, the authoring committee defined low-LET radiation as levels up to about 100 mSv. For comparison, a chest X ray averages around 0.1 mSv. The committee concluded it's likely that about 1 out of 100 people would develop a tumor or leukemia from exposure to 100 mSv above background. Of that same 100 people, experts would expect 42 to develop cancers for other reasons, but at the press conference marking the release of the report, the committee said it did not fully exclude the possibility of some radiation exposure being a factor in those cases.

The BEIR VII report employed statistical data to draw its conclusions and reviewed

studies of people exposed at work and in medical settings. It also relied heavily on data from the Japanese atomic bomb survivors.

As these survivors age, more is revealed about the relationship between radiation exposure and eventual health outcomes. Investigators have also improved their estimate of the levels of exposure this population received. But critics question the heavy reliance on the Japanese survivors because of the "healthy survivor" effect—those who survived the bombing might have been harder than those who died early on, potentially skewing the results.

Many researchers say the latest report helps reaffirm the general accuracy of federal standards in place for limiting health risks from low-level radiation. "We believe the data are more convincing than fifteen years ago and show that the radiation protection standards we use are reasonable," says Monson.

Mike Boyd, a health physicist who works on setting and updating those standards for the Environmental Protection Agency, concurs. "I don't think we'll be changing any federal standards," he says. "I'm not willing to say there will be no impact. This report will go into our estimation of risk and could lead to refinements, but generally standards should stay the same."

Although most scientists agree the report incorporated the majority of pertinent data up through 2003, information about low-LET radiation continues to emerge. One hypothesis under investigation, says biologist Andrew Wyrobek of Lawrence Livermore National Laboratory, is the possible adaptive response cells developed over eons of natural exposure. Other hypotheses include genetic instability (the idea that some cells already have genetic mutations and are thus more prone to becoming cancerous, given the incentive) and the "bystander effect" (in which cells respond adversely to nearby irradiation although they themselves weren't hit directly). These concepts were among those reviewed for the BEIR VII report but were not incorporated into the risk estimates.

Most experts agree that the BEIR VII report won't be the last in the series. "Right now there is just a lot we don't know about how cells react to very low doses of radiation," says Wyrobek. "But with multiple exposures from more and more people undergoing medical diagnostics in the low-dose range, and increased amounts of radioactive waste, it's important to understand these ranges better." Says Boyd, "I will be excited to see some future academy report after we find out more about how radiation affects cells at very low doses."

—Sarah Todd Davidson

Smoke-Free Beijing Olympics

WHO officials announced in April 2005 that the 2008 Beijing Olympic Games will be smoke-free, a ban the city's mayor has personally endorsed.

Experts say the move signals an official effort by China to heighten awareness of the dangers of smoking among its population, of whom 360 million smoke. The 2000 Sydney Olympics were smoke-free, but smoking was permitted at some venues of the 2004 Athens games.

China is a signatory of the WHO Framework Convention on Tobacco Control, yet as the world's largest tobacco producer it faces challenges in reducing smoking among its population. Sharing cigarettes is a form of social courtesy, and 67% of Chinese males smoke. The WHO estimates at least 1.3 million Chinese die each year from smoking-related illnesses.



Nuclear Cleanup Slowdown

In 2002, the U.S. DOE began an accelerated cleanup program for nuclear waste aimed at reducing cleanup costs by \$50 billion and shortening the timeline by 35 years. In July 2005, the GAO released a review of this program which found that progress is varied among the 16 cleanup activities measured. The DOE is ahead of schedule on packaging nuclear materials for disposal, disposing of low-level waste, and removing buildings, but lags on the tougher and costlier tasks of disposing of transuranic and radioactive tank wastes and closing tanks that contained radioactive waste. Because of these factors the DOE is not likely to achieve its full estimated cost and time reduction. The GAO advised the agency to revise its performance reporting and better highlight critical activities that will help it meet its goals.

Flush with Progress

The homeless population of Vancouver, British Columbia, has doubled in recent years. Now high populations of homeless persons and drug abusers have created an unsanitary problem for the city—streets, alleys, and parking lots around the downtown are habitually used as outdoor toilets. The city is now purchasing several new high-tech, self-cleaning bathroom booths—at up to \$300,000 apiece—to be installed in critical areas, with an urban anthropologist to pinpoint major problem spots. The city is looking at a stainless steel model that cleans and dries every surface of its interior after each use.



INFORMATION TECHNOLOGY

This Is YourAir Calling

Consider the following scenario: You're making last-minute preparations the night before a planned day of outdoor activities. Suddenly your cell phone rings. It's not a friend or relative, but a text message warning you that air pollution levels will spike near your destination the next day. If you suffered from asthma or heart disease, this would be crucial information—high levels of air pollution can trigger life-threatening reactions in vulnerable people. With prior knowledge of the risk, you might take steps to limit your exposure and protect your health.

Thanks to a pilot project called YourAir, subscribers in some areas of London, England, are getting just this type of service. Coordinated by the European Space Agency (ESA) and Cambridge Environmental Research Consultants (CERC), YourAir calls subscribers with text message alerts on evenings before high levels of ozone, nitrogen dioxide, and particulates are predicted in their locations.

YourAir currently serves Central London and the boroughs of Croydon, Camden, and Wakefield. Iarla Kilbane-Dawe, a senior scientist with CERC, predicts the service will cover all of London and its population of 7 million by next year. The effort was developed as a demonstration service of ESA's PROMOTE project, which uses real-time atmospheric data to improve quality of life and public decision making.

Subscribers to the free service are recruited through newspaper ads. They provide



Get the message? A pilot project in the United Kingdom sends text messages to people at risk for complications from severe air pollution, warning of days when it might be safer to stay inside.

CERC with a street address or postcode, and are alerted only when pollution levels in that area are expected to rise. According to Kilbane-Dawe, YourAir integrates measurements of transboundary pollution movements generated by an ESA satellite with weather forecasts and knowledge of local traffic patterns. Through this approach, citizens get high-resolution air quality predictions at the street-by-street level.

YourAir also has a web-based interface, located at <http://www.cerc.co.uk/YourAir/index.asp>, that provides air quality predictions for all of Central London. With upcoming improvements to the site, Kilbane-Dawe says "you'll be able to zoom in, pan, and scroll the air quality map and even look at air quality in the vicinity of individual houses."

A key goal of the first-of-its-kind service is to enhance the medical community's predictive capacity. For instance, pharmacies are more likely to run out of inhalers when pollution levels rise, and better air quality predictions might alert them to stock up in advance. "Air pollution alerts are a growth area," Kilbane-Dawe says. "We think we'll have air pollution issues in London for another twenty years at least." —**Charles W. Schmidt**

ALLERGIES

The Radical Theory of Sneezing

Anyone with common seasonal allergies knows perfectly well what's causing their misery: pollen! And allergists know why pollen makes people sneeze: the body's immune system is releasing a lot of inflammatory cells, including neutrophils and eosinophils, in response to the invading pollen proteins. However, new research reveals that it's more than just pollen's proteins wreaking havoc on human airways.

Earlier work had shown that the inflammatory cells the body spews out in response to pollen harbor enzymes called NADPH oxidases. Now researchers report in the August 2005 *Journal of Clinical Investigation* that even before the immune system cranks up, NADPH oxidases in pollen itself generate a type of free radical known as reactive oxygen species (ROS), which interfere with cell signaling pathways and cause the immune system to overreact.

"We demonstrate for the first time to our knowledge that pollen extracts from weeds, trees, and grasses have intrinsic NADPH oxidase activity that induces ROS in airway epithelium within minutes," the team writes. ROS are formed when NADPH oxidases interact with cells lining the airways. The result is oxidative stress, which health experts suspect exacerbates asthma and allergies. Pollen's double whammy causes the often quick, intense allergic reaction seen in sensitized patients, explains lead author Istvan Boldogh, a molecular biologist at the University of Texas Medical Branch at Galveston.

The surprising new findings reveal that "pollen is more active than we thought," says J. David Lambeth, a molecular biologist at

Emory University School of Medicine, who wrote a commentary on the study for the same journal. "We knew that pollen can make the body make free radicals, but this study shows that pollen takes an active role in making free radicals itself," he says.

Plant cells were known to contain NADPH oxidases similar to those found in white blood cells in humans and other mammals. Among other important functions, the oxidases protect the plant against pathogens. However, researchers had not tested pollen for NADPH oxidases, says Boldogh. He and his colleagues uncovered pollen's double-barreled effect on lungs by exposing sensitized mice to different forms of pollen, some with excess NADPH oxidases added, others that were NADPH-free. When they eliminated the NADPH oxidase activity, the mice had little or no inflammation in their airways and produced few of the cells that indicate an allergic response. When the researchers tested the effects of pollen extracts on cells taken from the lining of the lung, they found that adding NADPH oxidase increased the intracellular levels of free radicals.

Patients may someday use an inhaler containing antioxidants to counter ROS and minimize the effects of pollen, says Boldogh. The team's recent studies show that a combination of the antioxidants ascorbic acid and *N*-acetyl-L-cysteine prevents airway inflammation in pollen-exposed mice.

But antioxidants available now clear from the lungs too quickly to be effective in people, so companies are looking into developing longer-lasting products, Boldogh says. However, the group warns against developing treatments for patients based on its single study, noting that the results are circumstantial and need to be established in patients, work the team is now attempting. —**Tina Adler**

ehpnet

Greener Education Materials
for Chemists

Green chemistry aims in part to help clean up chemical processing by reducing or eliminating toxic elements from production and use. One university at the forefront of the movement is the University of Oregon, which has developed a website, Greener Education Materials for Chemists (GEMS), to educate teachers on introducing green chemistry concepts to their students. Although the site, located at <http://greenchem.uoregon.edu/gems.html>, currently contains only materials for university-level education, the developers hope to eventually include content for K–12 teachers.

The site consists of a database of print resources, which visitors can search using free text or by selecting search terms from seven categories, including chemistry concepts, laboratory techniques, green chemistry principles, and chemistry sub-disciplines. Each item in the database has an overview that summarizes its content and its connection to green chemistry as well as contact information for the person that contributed the material to the database.



The different types of material that are currently available on the site, which is partially funded by the National Science Foundation, include laboratory exercises, lecture materials, course syllabi, and multimedia content. To aid educators in determining which materials best suit their needs, threaded discussions will soon be included for each item. Here educators will be able to discuss how they integrated materials into their lesson plans and relate their success in using them.

The site, unveiled in June 2005 at an American Chemical Society meeting, was developed by a partnership between the university's Green Chemistry Group and Center for Educational Technologies. Students and high school teachers were involved in the design of the site, as were more than 100 college instructors who attended national green chemistry education workshops at the university. The site's developers have provided information on the site advising people how to contribute material to the database. They are also looking for educators to evaluate materials, test laboratory procedures, and adapt content for varying age groups. The developers want the website to be as inclusive as possible so it can serve as many grade levels and subject areas as possible.

A link to information about the university's Green Chemistry Center is sited in the toolbar at the top of the homepage. Here visitors can find an overview of the program's work in developing undergraduate green chemistry curricula, the history of the program, and media coverage. A description of *Green Organic Chemistry: Tools, Strategies and Laboratory Experiments*, a textbook/laboratory manual released in 2004 for the undergraduate organic chemistry laboratory, is available from this page as well. —Erin E. Dooley

Heavy Metals in Ayurvedic
Meds

Health Canada has issued a warning to consumers following a 15 December 2004 *JAMA* report that 1 in 5 Ayurvedic medicinal products made in South Asia and sold in the Boston area contained potentially harmful levels of lead, mercury, or arsenic. Ayurveda (Sanskrit for "science of life") often employs heavy metals because of their purported therapeutic properties.

Although none of the products tested are authorized for sale in Canada, the agency suspects some are sold there nonetheless. The agency tested one product, sold as a blood purifier for skin diseases and digestive problems, and found more than 40 times the allowable concentration of arsenic. Health Canada is reviewing the *JAMA* findings and assessing availability of the products in Canada, with results posted on the agency's website.



Ecolabeling for Fisheries

As concern over the fate of wild marine fish stocks grows, the UN Food and Agriculture Organization took action in March 2005 by adopting a set of voluntary guidelines for the ecolabeling of fish products. These guidelines advise governments and organizations that oversee or plan to implement labels for fish and fishery products from well-managed marine capture fisheries. Included are minimum requirements and criteria for determining whether a fishery should be certified to use the ecolabel, based on the agency's Code of Conduct for Responsible Fisheries. The guidelines, acknowledging the financial and technical challenges faced by developing nations in managing their fisheries, call for support in these areas to help these countries implement and benefit from the program.

Wildfire Pollution
Widespread

Research by the U.S. National Center for Atmospheric Research in the 14 June 2005 issue of *Geophysical Research Letters* shows that particularly intense wildfires in Alaska and Canada during the summer of 2004 emitted as much carbon monoxide as human activities in the continental United States during the same period. The fires also boosted ground-level ozone across the northern continental United States, even increasing levels of this pollutant by 10% as far away as Europe. The researchers used a novel combination of satellite-based observing instruments, computer models, and numerical techniques to help them distinguish between fire-generated carbon monoxide and that from other sources.

